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GRAMMATICAL AND ASSOCIATIVE FACTORS IN SENTENCE RECALL--A PRELIMINARY REPORT.

BY- ROSENBERG, SHELDON
MICHIGAN UNIV., ANN ARBOR,CTR.FOR RES.LANG.AND BEH

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THE RESEARCH REPORTED HERE WAS CARRIED OUT TO EVALUATE THE POSSIBILITY THAT IN THE RECALL OF SIMPLE DECLARATIVE SENTENCES THE SUBJECT-NOUNS ARE EASIER TO RECALL THAN THE OBJECT-NOUNS. SUBJECTS (198 UNDERGRADUATES) WERE EXPOSED TO DECLARATIVE SENTENCES THAT VARIED IN ASSOCIATIVE STRENGTH, SENTENCE TYPE (ACTIVE-PASSIVE), AND THE CLASS OF THE OBJECT-NOUN (ANIMATE-INANIMATE). SENTENCE TYPE WAS VARIED IN AN ATTEMPT TO MANIPULATE THE POSITION OF THE SUBJECT-NOUN AND THE POSITION OF THE OBJECT-NOUN. ASSOCIATION AND SENTENCE TYPE WERE "BETWEEN" VARIABLES, WHILE OBJECT-NOUN CLASS WAS A "WITHIN" VARIABLE. IN AN IMMEDIATE RECALL TEST, HIGH-ASSOCIATION (HA) SENTENCES WERE EASIER TO RECALL THAN LOW-ASSOCIATION (LA) SENTENCES, REGARDLESS OF SENTENCE TYPE OR OBJECT-NOUN CLASS. HOWEVER, LA INANIMATE-OBJECT SENTENCES WERE EASIER TO RECALL THAN LA ANIMATE-OBJECT SENTENCES. FOR ACTIVE SENTENCES THERE WAS NO DIFFERENCE IN RECALL AS A FUNCTION OF OBJECT-CLASS, BUT FOR PASSIVE SENTENCES MORE INANIMATE-OBJECT SENTENCES WERE RECALLED THAN ANIMATE-OBJECT SENTENCES. RECALL OF THE SUBJECT-NOUNS AND THE OBJECT-NOUNS FROM THE SENTENCES VARIED AS A FUNCTION OF ASSOCIATION AND SENTENCE TYPE, BUT NOT AS A FUNCTION OF OBJECT-NOUN CATEGORY. FOR HA ACTIVE, HA PASSIVE, AND LA PASSIVE SENTENCES, THERE WERE NO DIFFERENCES IN THE RECALL OF SUBJECT-NOUNS AS COMPARED WITH OBJECT-NOUNS. HOWEVER, IN THE CASE OF LA ACTIVE SENTENCES, MORE SUBJECT-NOUNS WERE RECALLED THAN OBJECT-NOUNS. THE VERBS OF THE HA SENTENCES (ACTIVE AND PASSIVE) WERE AS EASY TO RECALL AS THE SUBJECT-NOUNS AND THE OBJECT-NOUNS, BUT THE VERBS OF THE LA SENTENCES (ACTIVE AND PASSIVE) WERE MORE DIFFICULT TO RECALL THAN THE SUBJECT-NOUNS OR THE OBJECT-NOUNS. THIS REPORT WAS PUBLISHED IN "STUDIES IN LANGUAGE AND LANGUAGE BEHAVIOR, PROGRESS REPORT IV," 1967, PUBLISHED BY THE CENTER FOR RESEARCH ON LANGUAGE AND LANGUAGE BEHAVIOR, UNIVERSITY OF MICHIGAN, 220 EAST HURON STREET, ANN ARBOR, MICHIGAN 48108. (AUTHOR/JD)

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Grammatical and Associative Factors in Sentence Recall: A Preliminary Report

Sheldon Rosenberg

Center for Research on Language and Language Behavior

Subjects were exposed to declarative sentences (in an immediate recall task) that varied in associative strength, sentence type (active-passive) and the class of the object-noun (animate-inanimate). Sentence type was varied in an attempt to manipulate the position of the subject-noun and the position of the object-noun. Association and sentence type were "between" variables, while object-noun class was a "within" variable. High-association (HA) sentences were easier to recall than low-association (LA) sentences, regardless of sentence type or object-noun class. However, LA inanimate-object sentences were easier to recall than LA animate-object sentences. For active sentences, there was no difference in recall as a function of object-class, but for passive sentences, more inanimate-object sentences were recalled than animate-object sentences. Recall of the subject-nouns and the object-nouns from the sentences varied as a function of association and sentence type, but not as a function of object-noun category. For HA active, HA passive and LA passive sentences, there were no differences in the recall of subject-nouns as compared with object-nouns. However, in the case of LA active sentences, more subject-nouns were recalled than object-nouns. The verbs of the HA sentences (active and passive) were as easy to recall as the subject-nouns and the object-nouns, but the verbs of the LA sentences (active and passive) were more difficult to recall than the subject-nouns or the object-nouns.

Psychologically, a sentence can be viewed as a device for displaying semantic relations. However, in decoding a sentence its semantic relations are arrived at by first identifying its grammatical relations, i.e., the abstract entities, such as "subject of", "object of" and "main verb" that are cues to its meaning. In some instances the grammatical cues essential to sentence understanding are signaled by the observable constituents of a sentence, but in other instances some meaning-bearing constituent(s) may have been deleted in the derivation of the sentence. For example, the subject--the indefinite "someone"--of the sentences, The ball was hit and The car was sold for the owner, has been deleted. The distinction between base structure and surface structure that one finds in generative transformational accounts of grammar (Chomsky, 1965) derives from such observations.

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From a psychological standpoint, the grammatical relations found in sentences may not be of equal importance. For example, the noun or noun phrase that signals "subject of" in a simple declarative sentence is related to the rest of the sentence, whereas the noun or noun phrase that signals "object of" is related only to the verb. For the student of verbal learning this would suggest that recall of the subject-noun may be superior to recall of the object-noun, and that the subject-noun may be a more effective prompt for recall of the sentence than the object-noun. The relationship between the verb and the other grammatical constituents of such sentences is more complex than the "subject of" and "object of" relations, since the verb relates to the object in one way and to the higher-order relationship between the subject and the object in another way. Because of this, the verb may be more difficult to recall and a less efficient prompt than either the subject-noun or the object-noun.

Unfortunately, the task of the psychologist, trying to evaluate hypotheses such as these, is complicated by the presence of a number of potentially-confounding variables. For example, it is often impossible to separate the effects of word class from the effects of sentence position; sentences may vary in the degree of associative constraint that exists between their word constituents; and there are certain word-class options and restrictions (e.g., the object of certain verbs can be either animate or inanimate) that further complicate the situation.

The present study was carried out to evaluate the possibility that in the recall of simple declarative sentences the subject-nouns are easier to recall than the object-nouns. The study was designed so that the positions of the nouns in the sentences, the degree of associative constraint between the words in the sentences, and the class of the object-nouns would vary. Sentence position and associative strength were "between Ss" variables and object-noun class was a "within-Ss" variable. In order to manipulate sentence position, half of the Ss in the experiment were exposed to active sentences and half to passive sentences (e.g., The dog chased the cat vs. The cat was chased by the dog). Associative strength was manipulated by giving half of the Ss in the experiment sentences that contained (according to controlled association norms) associatively-related words, while the other half received sentences that contained associatively-unrelated words (e.g., The dog chased the cat vs. The dog liked the hen). Within each of the Sentence-Position X Association combinations,

half of the sentences contained animate nouns and half inanimate nouns (e.g., The dog chased the cat vs. The maid cleaned the house).

Since the words in sentences that are associatively well-integrated are not likely to differ very much in recall (see Rosenberg, 1966b and the article "Associative facilitation and interference in the recall of sentences" of this report for some evidence that relates to this point), it was anticipated that, if there is a difference in the recall of subject-nouns and object-nouns, it is more likely to appear when low association (LA) sentences are used than when high association (HA) sentences are used. It was anticipated that the effect of the presence of inanimate, as compared with animate objects, would most likely be to reduce the likelihood of subject-object reversal in recall.

In view of the fact that passive sentences tend to be grammatically more complex and longer than active sentences, it is possible that in manipulating the position of the subjects and objects we are also manipulating sentence difficulty. To guard against this possibility (specifically, the possibility of an interaction between sentence difficulty and the subject-object dimension, sentence position was made a "between Ss" variable in the present study in the hope that exposure to sentences of a single type would establish a set that would reduce any difference in learning difficulty that might exist between passives and actives. However, it should be mentioned that the learning literature (Mehler, 1963; Martin & Roberts, 1966) contains conflicting results with respect to the question of the level of difficulty of passives. Sentence type was a "within-Ss" variable in these studies.

Method

Subjects. There were 128 undergraduate Ss in the present study. All were volunteers and all were paid for participation. They were assigned at random to four groups of 32 Ss each, as they appeared for the experiment. The data were collected in five group-testing sessions. The number of Ss tested in each session varied from 23 to 28, and the number of Ss in each experimental group that were tested in each session varied from 5 to 8.

Materials. Eight lists of eight sentences--two lists for each condition--were prepared for use in the present study. Each list contained four animate-object sentences and four inanimate-object sentences. The basic experimental lists were designated high association active (HA-A), low association active (LA-A), high association passive (HA-P) and low association passive (LA-P).

As already indicated, four of the sentences in each of these lists had animate (AN) objects and four had inanimate (IN) objects. Thus HA-A-AN indicates the high association-active-animate-object sentences. Each condition was represented by two different lists of sentences to control for the possible effects of the content of specific sentences.

Examples of the sentences from the various conditions were given in the introduction. HA sentences contained words which were associatively related to each other and LA sentences contained words which were associatively unrelated to each other. The HA and LA sentences were constructed with the assistance of associative sentence norms (see Rosenberg 1966a) for active declarative sentences. To produce these norms, Ss were asked to associate a verb and an object-noun to a sentence frame like the following: The doctor _____ the _____. The HA sentences were constructed by selecting the most frequently occurring response in the verb and object positions. LA sentences contained the same nouns as HA sentences but the verbs and objects were selected from the bottom of their associative hierarchies. The LA sentences were not semantically anomolous; they were matched with the HA sentences as closely as possible on the Thorndike-Lorge (1944) frequency of their word constituents, and on the length of their word constituents. An attempt was made to use only concrete nouns in the various sentences. In addition, there was no evidence to suggest that any of the experimental lists were differentially weighed with respect to intralist relationships. The sentences were selected so that the past tense inflection of the main verb in the passive construction would be the same as the past tense inflection in the active construction. Also, the auxiliary "was" appeared in each of the passive sentences.

The sentences were printed in booklets (one sentence to a page) that contained materials for four study-test trials. The order of sentences varied from trial to trial in each condition. There were four different within-list orders and four different between-trials orders in each condition. The booklets contained blank lined cards for use in written recall tests. The interval of exposure was timed with a metronome and the recall interval with a stopwatch.

Procedure. As indicated earlier, the data were collected in a group-testing situation. The booklets for the various conditions and orders were arranged haphazardly (with the restriction that we would begin with an equal number of booklets in each condition in each session) and were given out to the Ss after

they seated themselves in the experimental room. They were given detailed instructions on the use of the booklets. They were told that their task was to try to learn as many of the sentences as they could during the study trial and to try to write down as many of the sentences as they could remember during the recall period. Each sentence was exposed for 5 sec., the written recall test lasted 2 min. and the inter-trial interval was 5 sec. The Ss were told that the order of the sentences within the list was not important but that the order of words within each sentence was. They were urged to put down whatever they could remember of a sentence during the recall test, even if they were not sure of an item and to put a dash down in each place where they could not supply a word. The signals to turn the pages and to begin and end the recall tests were delivered verbally.

Results and Discussion

The recall protocols were scored initially for the total number of sentences recalled correctly over the four trials. The only allowances that were made in scoring for sentence recall were for minor spelling errors (cases in which there was no question about the word that was intended) and for changes in the articles from "the" to "a". In other words, this measure was for verbatim recall. Table 1 contains the means and SDs for this measure. Since the trends

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Insert Table 1 about here

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for the two lists of sentences within each condition were very similar and the differences between the two lists very slight, the results for the two lists were combined. It is obvious immediately that HA sentences were easier to recall than LA sentences in each of the groups. In addition, there was a tendency for LA-IN sentences to be easier than LA-AN sentences. This appears not to have been the case for HA sentences. There was little difference in the recall of P-IN sentences and A-IN sentences, but A-AN sentences were easier to recall than P-AN sentences.

An analysis of variance was carried out on these data with Association and Sentence Position (Sentence Type) as between variables, and Object-Noun Class as a "within variable". The effect of Association was highly significant, F (1,124) = 78.70, $p < .001$, but the effect of Sentence Position was not, F (1,124) = 3.32, $p > .05$). The interaction between Association and Sentence

position did not even approach significance. The effect of Object-Noun Class was also highly significant, F (1,124) = 25.00, $p < .001$, as was the interaction between Association and Object-Noun Class, F (1,124) = 18.64, $p < .001$, and the interaction between Sentence Position and Object-Noun Class, F (1,124) = 17.73, $p < .001$. The triple interaction was not significant.

The source of the significant interaction between Association and Object-Noun class becomes apparent when one combines the data for active and passive sentences. There were clearly more LA-IN sentences recalled than LA-AN sentences. There was only a slight difference, however, between HA-AN sentences and HA-IN sentences. One possible explanation for these findings is that subject-object reversal errors are more likely to occur in the recall of LA-AN sentences than in the recall of associatively well-integrated AN sentences.

If one combines the data for the HA and LA sentences, the source of the significant interaction between Sentence Position and Object-Noun Class can be identified. More P-IN sentences were recalled than P-AN sentences, but the difference between A-AN and A-IN sentences was very small. Here, also, it is possible that subject-object reversal errors are more likely to occur in the recall of P-AN sentences than in the recall of A-AN sentences. The error data relevant to these and other hypotheses are being analyzed, and the results will be described in a subsequent report.

Table 2 contains the principal data of the present study. These are the means for the total number of subject-nouns, object-nouns and verbs

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Insert Table 2 about here

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recalled correctly over the four trials. With the exception of the verb, the grammatical function of which was confounded with sentence position in the present study, the data are tabulated according to grammatical function rather than sentence position. In order to be counted correct on this measure, the sentence position and the grammatical function of a word had to be correct. With respect to grammatical function, there had to be nothing in the recalled sentence or sentence fragment to indicate that the grammatical function of a word was different from what it was in the original sentence. A preliminary analysis of the data showed the Subject-Verb-Object relationships for words from animate- and inanimate-object sentences to be identical in each of the four experimental groups. Table 2, therefore, does not contain a breakdown according to whether a word came from an animate- or an inanimate-object sentence.

The Subject-Verb-Object recall differences appear to be very small in Groups HA-A and HA-P. However, this was not the case in Groups LA-A and LA-P. In Group LA-A, more subjects were recalled than objects, and both subject and object recall were superior to verb recall. In Group LA-P, on the other hand, while both subject and object recall were superior to verb recall, object recall was only slightly superior to subject recall.

An analysis of variance revealed that the words from HA sentences were easier to recall than the words from LA sentences, F (1,124) = 60.46, $p < .001$, and that the words from A sentences were easier to recall than the words from P sentences, F (1,124) = 4.30, $p < .05$. The interaction between Association and the A-P variable was not significant. The Subject-Verb-Object variable was also a significant source of variance, F (2,248) = 25.00, $p < .001$, as was each of the remaining interactions. It is important to note at this point that when a total-words measure of recall was used, Sentence Type was a significant source of variance. This effect, however, appears to be complexly related to the effects of the other variables.

The most important finding of this analysis is that the Subject-Verb-Object variables interacted significantly with all of the other variables. Pairwise comparisons were made among the subjects, verbs and objects in each of the experimental groups, the results of which revealed, first of all, that none of the differences in Groups HA-A and HA-P was significant. There was no evidence, in other words, to indicate that either grammatical function or sentence position makes any difference in the recall of words from associatively well-integrated sentences. It will be interesting to see whether there are no differences in the effectiveness of a subject prompt as compared with an object prompt in the recall of HA sentences.

In Group LA-A we find a recall pattern that is consistent with the hypotheses concerning the relative importance of the "subject of", "object of", and verb relations in declarative sentences. Here, significantly ($p < .01$) more subject-nouns were recalled than object-nouns, significantly more subject-nouns than verbs, and significantly more object-nouns than verbs. Unfortunately, this recall pattern was not found in Group LA-P. In Group LA-P, subject-nouns and object-nouns were both significantly superior to verbs, but the difference between subject-nouns and object-nouns was not significant. As can be seen from the means in Table 2, what appears to have happened here is that the subject-nouns in the LA-P sentences were more difficult to recall than the subject-nouns in the LA-A sentences.

The results for LA-P sentences do not conform to either the linguistic hypothesis concerning the relative importance of the subject-noun and the object-noun, of the serial position hypothesis, which would make the noun in the beginning of the sentence easier to recall than the noun at the end. This finding, coupled with the results for HA sentences, indicates that the recall of words from sentences is the result of a complex interaction of variables, only some of which can be identified at present.

The results for sentence recall are interesting in that they demonstrate the importance of a variable--word-class subcategory--with which psychologists interested in sentence learning have not yet been concerned. However, word-class subcategory did not relate differentially to the recall of the subject-nouns, verbs, and object-nouns from the sentences. It should be mentioned here again that the verb class in the present study was confounded with sentence position.

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Table 1
Means and Standard Deviations
for Sentence Recall

Group	Mean	SD
HA-A-AN	14.28	1.63
HA-A-IN	13.59	1.64
LA-A-AN	10.59	2.15
LA-A-IN	11.56	2.08
HA-P-AN	12.88	1.79
HA-P-IN	13.81	1.23
LA-P-AN	9.25	3.40
LA-P-IN	11.75	2.17

Table 2
Mean Number of Subjects, Verbs
and Objects Recalled in each Group

Group	Grammatical Function		
	Subject	Verb	Object
HA-A	28.97	28.81	28.78
HA-P	27.53	28.16	27.69
LA-A	26.91	23.47	24.87
LA-P	24.50	23.09	24.94